BACKGROUND OF INVENTION

Field of Invention:

This invention relates generally to tapes for sealing cartons and other articles fabricated of recyclable material, and more particularly to a paper-film laminate sealing tape for this purpose, which is adherable to the article to be sealed and is strippable therefrom, in toto, so that no portion of the tape remains that would interfere with recycling the article.

Status of Prior Art:

Because of rising environmental concerns, in recent years stress has been placed on the use of products fabricated of materials which can be recycled. Thus a strong preference now exists for bags, cartons and other articles made of paper, for these can then be recycled. This is not true of most products made entirely or in part of synthetic plastic materials.

Thus a corrugated board carton lends itself to recycling, but not if the carton has a synthetic plastic film liner to render it water-resistant. A similar problem is encountered when use is made of a standard fiberglass-reinforced paper tape to seal the carton. This tape has its inner and outer paper plies laminated together by a hot melt polymeric adhesive, the nature of which is such that it is not compatible with recycling operations in which the carton is shredded in a beater and a slurry is then formed of the shredded material for further processing.

In a standard fiberglass-reinforced sealing tape, two plies of Kraft paper which are laminated together by a hot melt adhesive, have sandwiched therebetween two superposed arrays of fiberglass strands. In one array,

parallel strands of fiberglass run longitudinally along the tape, while in the other the parallel strands run in the cross direction at an angle to the longitudinal strands. The paper plies each have a thickness of 2 to 3 mils, and this plus the thickness of the two arrays of strands result in an overall tape thickness that when the tape is wound into a roll having a 7-inch diameter for use in a conventional manually or electrically-operated tape dispenser, the tape capacity of the roll is relatively low. Clearly, the thinner the tape, the greater the yardage of tape contained in a 7-inch diameter roll. But with a relatively thick laminated paper tape having two arrays of fiberglass sandwiched between its plies, the limited yardage in a roll of this tape gives rise to practical problems.

Thus when the tape dispenser is in uninterrupted use in sealing operations for mass-produced cartons, the tape roll is quickly exhausted, thereby making it necessary to put a fresh roll in the dispenser at frequent intervals. And because the hot melt adhesive in the tape tends to build up on the cutting blade of the dispenser, it becomes necessary from time to time to shut down the dispenser to clean this blade. And since each 7-inch diameter tape roll contains a limited yardage of tape, the storage space required for an adequate stock of such tape is high.

Moreover, when the paper/paper sealing tape is used to seal and hold together a carton that in the course of shipment becomes exposed to rain or snow, the paper tape will absorb water which may leak into the carton.

And the wet tape may be so weakened as to cause it to give way, with a resultant collapse of the carton.

But quite apart from the drawbacks of a standard reinforced paper/paper tape in the context of tape dispensers are the problems encountered when manufacturing a tape of this type in a conventional laminator. In manufacturing, two Kraft paper webs are continuously fed into the laminator, the surface of one web having first applied thereto a coating of hot melt adhesive. Also continuously fed into the laminator are the longitudinal and cross arrays of fiberglass strands. The need to feed separate arrays of fiberglass strands into the laminator dictates a relatively slow operating speed, with a resultant low tape production rate per hour.

Also, the hot melt adhesive must be maintained in a heated state while the laminator is in operation. And because this hot, flowable adhesive tends to drip over the operating mechanism of the laminator, it becomes necessary from time to time to shut down the laminator and use solvents to clean it. The use of volatile solvents may lead to troublesome environmental problems.

The above-identified copending patent application discloses a sealing tape in which an inner or base ply of paper is cold laminated to an outer or face ply of synthetic, plastic-film material of much higher strength than the paper, a longitudinal array of fiberglass strands being sandwiched between the plies. The film face ply and the fiberglass strands adhered thereto can readily be delaminated from the paper base ply adhered to a carton

sealed by the tape, for the fibers of the paper base ply are ruptured when stripping off the plastic film face ply.

Thus when the tape is used to seal a carton fabricated of a recyclable paper material, the plastic film face ply of the tape and the fiberglass strands adhered thereto, which are not recyclable, may be stripped off, leaving behind only the paper base ply, so that the carton can then be recycled in a paper recycling process.

In the 1977 patent to Williams, 4,041,202, there is disclosed a laminated tape particularly adapted for making carton joints and for sealing the flaps of cartons which can be easily stripped to free the joints of the flaps. The tape has a Kraft paper upper layer and a paper bottom layer of low internal bond strength with filaments between the layers, all united. The tape is applied in the usual manner to carton panels or flaps. To open the carton or separate the joints, the tape is stripped by pulling up one end. In this stripping action, the bottom layer delaminates the adhesive and parts of the low internal bond bottom layer.

In the 1982 patent to Williams, 4,351,877, there is disclosed a multiple layer laminated tape having an upper strength layer made of a pre-stretched polypropylene film which is laminated to a weak lower carrier layer of thin, low internal bond Kraft paper. The carrier layer has a coating thereon of a water-soluble adhesive which is used to apply the tape to separable portions of a cardboard carton. The carrier layer serves only as a medium to

"carry" the water soluble adhesive and also to provide sufficient longitudinal rigidity to permit dispensing of the tape from a standard Kraft paper type tape dispensing machine. Stripping the tape from a carton pulls away the upper plastic layer and splits the Kraft carrier layer that has low internal bond, leaving only so thin a layer of Kraft paper on the carton that it can very easily be broken to permit opening of the carton.

The 1985 patent to Williams, 4,557,971, discloses a sealing tape in which a paper face layer, providing a surface suitable for printing or marking is laminated to an intermediate polypropylene film layer which, in turn, is laminated to a weak carrier layer of low bond Kraft paper. The exposed surface of the paper carrier layer is coated with a water-soluble adhesive which is used to adhere the tape to a carton. Because the intermediate film layer is stronger than the carrier layer, when one wishes to remove the sealing tape from the carton so that the flaps of the carton can be opened, the film layer is stripped off, leaving the carrier layer adhered to the flaps of the carton. Since the carrier layer is of weak paper, it can readily be broken to release the flaps.

SUMMARY OF INVENTION

The main object of this invention is to provide a sealing tape for sealing a carton or other article formed of recyclable material, the tape being constituted by a paper-plastic film laminate which, though thin, is of high strength, the tape being strippable, in toto, from the article which can then be recycled, for no portion of the tape remains on the article.

More specifically, an object of the invention is to provide a tape of the above type in which a base ply of biaxially-oriented, synthetic plastic film, whose opposing surfaces are treated to render them wettable and receptive to adhesives, is laminated by an adhesive to a face ply of paper, the exposed wettable surface of the base ply having a coating thereon of a moistenable adhesive, so that the tape can be adhered to the article to be sealed.

A significant feature of the invention is that cold lamination is used; hence no heat is applied to the non-permeable film of the base ply that would impair its orientation and weaken the film, whereas the paper face ply laminated thereto is permeable and affords a printable surface which may be used to mark the tape.

Briefly stated, these objects are attained in a paper-film laminate sealing tape for sealing a carton or other article fabricated of recyclable material. The tape is composed of a base ply formed of high-strength, synthetic plastic film having wettable surfaces receptive to adhesives and a paper face ply which is cold-laminated by an adhesive to the base ply. The exposed surface of the base ply is coated with a remoistenable adhesive, so that when this adhesive is moistened in a tape dispenser, the sealing tape can then be adhered to the carton. The tape may be reinforced by a longitudinally array of fiberglass strands sandwiched between the base and face plies. Because of the high strength of the base ply relative to that of the material from which the carton is made, the tape may be stripped, in toto, from the carton so that the carton can be recycled.

BRIEF DESCRIPTION OF DRAWINGS

For a better understanding of the invention as well as other objects and further features thereof, reference is made to the following detailed description to be read in conjunction with the accompanying drawings, wherein:

Fig. 1 is a cross section taken through a sealing tape in accordance with the invention, the thickness of whose plies is grossly exaggerated;

Fig. 2 is a plan view of the tape whose paper face ply is cut away to expose the plastic film base ply;

Fig. 3 schematically shows a single stage system for manufacturing the tape;

Fig. 4 shows a carton sealed with the tape; and

Fig. 5 is a plan view of a modified tape in which fiberglass reinforcing strands are sandwiched between the plies.

DESCRIPTION OF INVENTION

The Tape:

Referring now to Figs. 1 and 2, a sealing tape T in accordance with the invention includes a face ply 10 formed of Kraft or other paper sheeting. Face ply 10 is cold laminated by an adhesive layer 11 to a base ply 12 of high-strength, synthetic plastic film, such as polyethylene. Preferably the film is formed of a biaxially-oriented material, such as polypropylene or polyester (MYLAR). The opposing film surfaces of the base ply are rendered wettable so that they are receptive to adhesives.

Coated on the exposed wettable surface of base ply 12 is a moistenable adhesive layer 13, so that the sealing tape can be adhered to a carton, a package or other article fabricated of recyclable material. The tape acts to close the flaps or joints of the carton or to carry out any other conventional sealing function.

The plastic film base ply 12 is preferably no more than one mil in thickness; hence, by itself, it lacks rigidity and body. The Kraft paper face ply 10 is thicker, preferably being 2 or 3 mils thick, thereby imparting a measure of stiffness and body to the tape.

When film ply 12 is biaxially-oriented, it has exceptional tensile strength, such orientation being effected by stretching the film along both its transverse and horizontal axes to molecularly orient the structure of the film. The strength of the paper face ply, alone, is not high, but the paper-film laminate has both body and high strength, so that a roll of the tape can be used in a standard Kraft paper tape dispenser in which the gummed side of the tape is moistened as the tape is drawn out of the dispenser.

Cold lamination of the plies is effected by a water-based adhesive, preferably a polyacrylic copolymer composition having an affinity both for the paper ply and the film ply. Because the water-based adhesive is fluid at ambient temperature and is not a hot melt adhesive, no heat is applied to the biaxially-oriented film as it is being laminated to the paper ply.

It is important to bear in mind that a biaxially-oriented film is heat-sensitive and that at elevated temperatures, the film relaxes and loses its molecular orientation and strength. It is known, for example, that when two sheets of biaxially-oriented polyester film are seamed together, using an ultrasonically-activated sealing bar for this purpose which creates internal friction and heat within the film, which causes the superposed films to soften and fuse, the resultant sealing line is weak, and the sheets then tend to tear along this line. Cold lamination is therefore essential to the present invention in order to produce a tape laminate of high strength.

The moistenable, water-soluble adhesive coating 13 on the exposed surface of plastic film base ply 10 is preferably a water-based starch or acrylic composition, or of any other composition conventionally used in gumming tape.

It is to be noted that a synthetic plastic film material, such as polypropylene, is normally not receptive to adhesives, especially water-based adhesives. Hence if one were to apply to the surface of this film a water-based

adhesive which is flowable at ambient temperature or at a temperature somewhat above ambient but not at the elevated temperature of a hot melt adhesive, the adhesive will not be adsorbed by the film. Essential to the invention is that the opposing surfaces of the film forming the base ply of the tape be treated so as to render them wettable and hence receptive to adhesives. To this end, these surfaces are subjected to a corona discharge treatment which enhances their surface energy, as measured in dynes, and thereby renders them wettable to allow for better bonding of adhesives applied thereto.

The Kraft paper face ply 12, which is formed of cellulosic fibers, is permeable and therefore receptive to printing and writing. Because of this, one may print on the paper face ply such notices a FRAGILE or HANDLE WITH CARE, or one may write with a marker pen on the tape. And in practice, a colored paper ply may be used to render the tape more attractive. And one can apply to the tape stick-on labels or adhere a second sealing tape thereover to further reinforce the seal. This would not be possible with a sealing tape whose exposed surface is that of a synthetic plastic film.

The Manufacturing System:

Fig. 3 schematically illustrates a single-stage system for producing a paper-plastic film laminate tape in accordance with the invention. The system includes a combining station having a pair of cooperating pressure rolls 14 and 15 driven at high speed by a motor 16. The nip between these rolls is appropriate to the thickness

of the webs to be laminated to provide the desired degree of laminating pressure to ensure secure bonding of the webs.

Fed concurrently into the nip of rolls 14 and 15 at the combining station are a web 17 of Kraft paper for forming the paper face ply 10 of the tape, and a web 18 of synthetic, plastic film material to form base ply 12. Web 17 is drawn from a Kraft paper supply reel 19 supported at an elevated position. Paper web 17 is drawn downwardly from this reel and is guided by an idler roll 20 into a horizontal path leading into the nip of the combining rolls.

Film web 18 is drawn from a film supply reel 21 which is placed at a position to feed film web 18 directly into a horizontal path toward the nip of the combining rolls. Reel 21 is placed well in advance of the combining station in order to expose a fairly long stretch of film web before it enters the combining rolls.

Along this stretch of biaxially-oriented film web 18 formed of a synthetic plastic material such a polypropylene having a high dielectric constant, is a first corona discharge electrode 22 which is spaced above the upper surface of the film to create an ionizable air gap therebetween. The film web runs along a ground electrode 22G in vertical alignment with discharge electrode 22. A high-frequency voltage having an amplitude sufficient to produce a corona discharge is applied to electrode 22. The corona discharge, which is directed toward the upper surface of the film web, increases the surface energy at the web surface to

render it wettable and therefore receptive to adhesives, but it does not affect the molecular orientation of the film.

Also along the stretch following the first discharge station 22-22G is a second corona discharge station for subjecting the undersurface of of film web 18 to a corona discharge to render this surface wettable so that it is receptive to an adhesive to be later applied thereto. The second station consists of a corona discharge electrode 23 which is spaced from the undersurface of web 18 to create an air gap therebetween, and a cooperating ground electrode 23G engaging the upper surface of the web.

Intermediate the second corona discharge station 23-23G and the combining station is an adhesive applicator 24 having a coating roll 25 which engages the now wettable upper surface of film web 18 and applies thereto the water-based, acrylic polymer adhesive for laminating the film web to the paper web to form the laminating adhesive layer 11 of the tape.

Thus concurrently entering the nip of pressure rolls 14 and 15 of the combining station at ambient temperature are paper web 17 and the adhesive-coated film web 18. These webs are subjected to pressure by pressure rolls 14 and 15, lamination being effected by this action.

The laminated webs from the combining station are wound on an output reel 26 driven by a motor 27 whose operation is synchronized with motor 16 driving the pressure rolls, for these motors together serve to draw the webs from their supply reels.

Output reel 26 is so spaced from the combining station as to provide a fairly long stretch sufficient to permit drying of the adhesives applied to the webs. In this stretch, below plastic film web 18 is an applicator 28 whose coating roll 29 engages the now wettable undersurface of film web 18 to coat this surface with the water-based adhesive forming the moistenable adhesive layer 13 on the plastic film underside of tape T.

Thus, wound on output reel 26 are the laminated paper and film webs, the exposed surface of the film web having a moistenable adhesive coating thereon. In practice, forced air dryers may be provided at positions following the combining station and following adhesive applicator 28 to fully dry the adhesives before the laminated webs are wound onto the output reel. And while the forced air is heated, the temperature thereof is well below an elevated temperature that would impair the biaxial orientation of the film.

Since a typical sealing tape has a width of two or three inches, and the webs from which these tapes are derived are much broader, the laminated paper-plastic film webs on output reel 26 are slit into tapes of the desired width by a conventional slitter having a bank of rotary slitter blades.

Applications:

Fig. 4 shows a corrugated board carton 29 having complementary flaps 30 and 31 which are sealed by a paper-film laminate tape T in accordance with the invention. To this end, the moistenable adhesive coating on the plastic

film underside of the tape is moistened in the tape dispenser so that the tape bridging the edges of the flaps can be adhered thereto to seal the carton.

When tape T is so applied, its paper face ply 10 is exposed. The surface of this ply is printable; hence if the carton contains articles made of glass, a FRAGILE GLASS notice may be stamped onto the tape.

While the carton may in the course of shipment be exposed to rain or snow, and this will wet the paper face ply, water cannot enter the carton, for the non-permeable plastic base ply which seals the carton acts as a water barrier. And because the strength of the tape is largely determined by the strength of the plastic film base ply, the tape will not be weakened by water even though its paper ply is wet.

But when the carton has served its purpose and is to be recycled, then before doing so, it is necessary to remove tape T, for its plastic film base ply is not acceptable to a paper recycling system. To remove tape T, it is simply stripped, in toto, from the carton, as shown in Fig. 4, for the plastic film base ply 12 which is adhered to flaps 30 and 31 is far stronger than the corrugated paper board stock of the flaps; hence when tape T is stripped off, the cellulose fibers on the surface of the flaps rupture to release the tape. Thus the tape is removed in toto from the carton which can now be recycled.

Modifications:

The modified tape TM shown in Fig. 5 is essentially the same as tape T shown in Fig. 1, except that it is reinforced with fiberglass strands which do not, however, significantly increase the thickness of the tape.

To this end, sandwiched between paper face ply 10 and plastic film base ply 12 is a longitudinal array of parallel fiberglass strands 32. Each strand 32 is composed of a small cluster of glass fibers, each preferably having a denier of 0.1. In practice, two fibers are sufficient to form a cluster, although a greater number may be used to enhance the strength of the tape.

In making a reinforced tape of this type, a system essentially the same as that shown in Fig. 3 may be used, the strands of fiberglass being drawn from supply reels and being fed into the nip of the combining rolls between the dry paper web 17 and the adhesive coated web film 18, so that the strands, before entering the combining station, are wetted by the laminating water-based adhesive.

While there has shown and described a preferred embodiment of a paper-film laminate sealing tape in accordance with the invention, it will be appreciated that many changes and modifications may be made therein without, however, departing from the essential spirit thereof. Thus, instead of a single-stage system to produce the tape, a two-stage system may be used, in the first stage of which the paper and plastic film webs are joined together, but the outer surface of the plastic film web is not yet coated with a moistenable adhesive. In the second stage, the fully dried, joined webs are drawn through an adhesive applicator which applies the moistenable adhesive to the outer surface

of the film web to form a wet coating which is then dried before the web is wound on an output reel or fed into a web slitter station.

In producing a sealing tape in accordance with the invention, it is not essential that the opposing surfaces of the plastic film web be rendered wettable by subjecting these surfaces to a corona discharge in a laminating machine, as shown in Fig. 3, before the film web is combined with the paper web. In practice, the film web may be pre-treated to render its opposing surfaces wettable, in which case the film web supply roll carries an already wettable film web, thereby dispensing with the need for including corona discharge stations in the laminating machine. However, even when the film web is so pre-treated, it may still be desirable to include corona discharge stations in the laminating machine in order to assure proper wettability of the opposing surfaces of the film web before adhesives are applied thereto.